US009583014B2

(12) **United States Patent**
Becker

(10) **Patent No.: US 9,583,014 B2**
(45) **Date of Patent: Feb. 28, 2017**

(54) **SYSTEM AND DEVICE FOR WELDING TRAINING**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 11 days.

(21) Appl. No.: **13/799,390**

(22) Filed: **Mar. 13, 2013**

(65) **Prior Publication Data**

US 2014/0134579 A1 May 15, 2014

Related U.S. Application Data

(60) Provisional application No. 61/724,322, filed on Nov. 9, 2012.

(51) **Int. Cl.**

G09B 19/00	(2006.01)
G09B 5/00	(2006.01)
B23K 9/095	(2006.01)
B23K 9/16	(2006.01)
B23K 9/32	(2006.01)
G09B 19/24	(2006.01)

(52) **U.S. Cl.**

CPC ***G09B 5/00*** (2013.01); ***B23K 9/095*** (2013.01); ***B23K 9/16*** (2013.01); ***B23K 9/32*** (2013.01); ***G09B 19/24*** (2013.01)

(58) **Field of Classification Search**

CPC B23K 9/095; B23K 9/0953; B23K 11/253; B23K 11/252; B23K 11/25; B23K 20/123; B23K 9/0956; G09B 19/24; G09B 25/02; B09B 9/00; G05B 2219/39021; G05B 2219/39026; G05B 2219/39024

USPC 434/219, 234, 260

See application file for complete search history.

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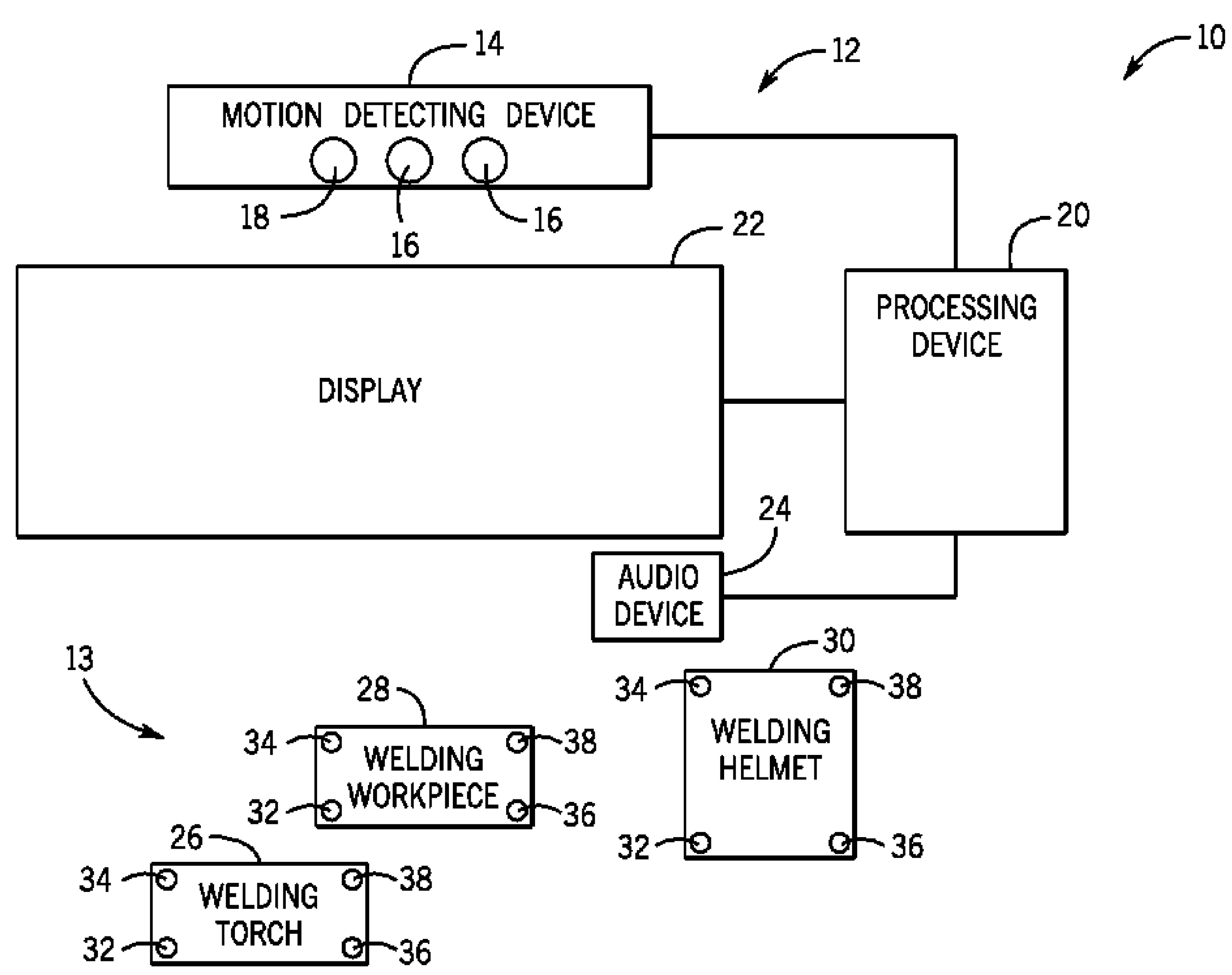
(57) **ABSTRACT**

A system and device for welding training. In one example, a welding training system includes a position detecting system configured to detect a distance between the position detecting system and objects within a field of view of the position detecting system, and to produce a map corresponding to the objects. The welding training system also includes a markers configured to be coupled to a device of the welding training system. Furthermore, the markers are configured to be detected by the position detecting system.

20 Claims, 6 Drawing Sheets



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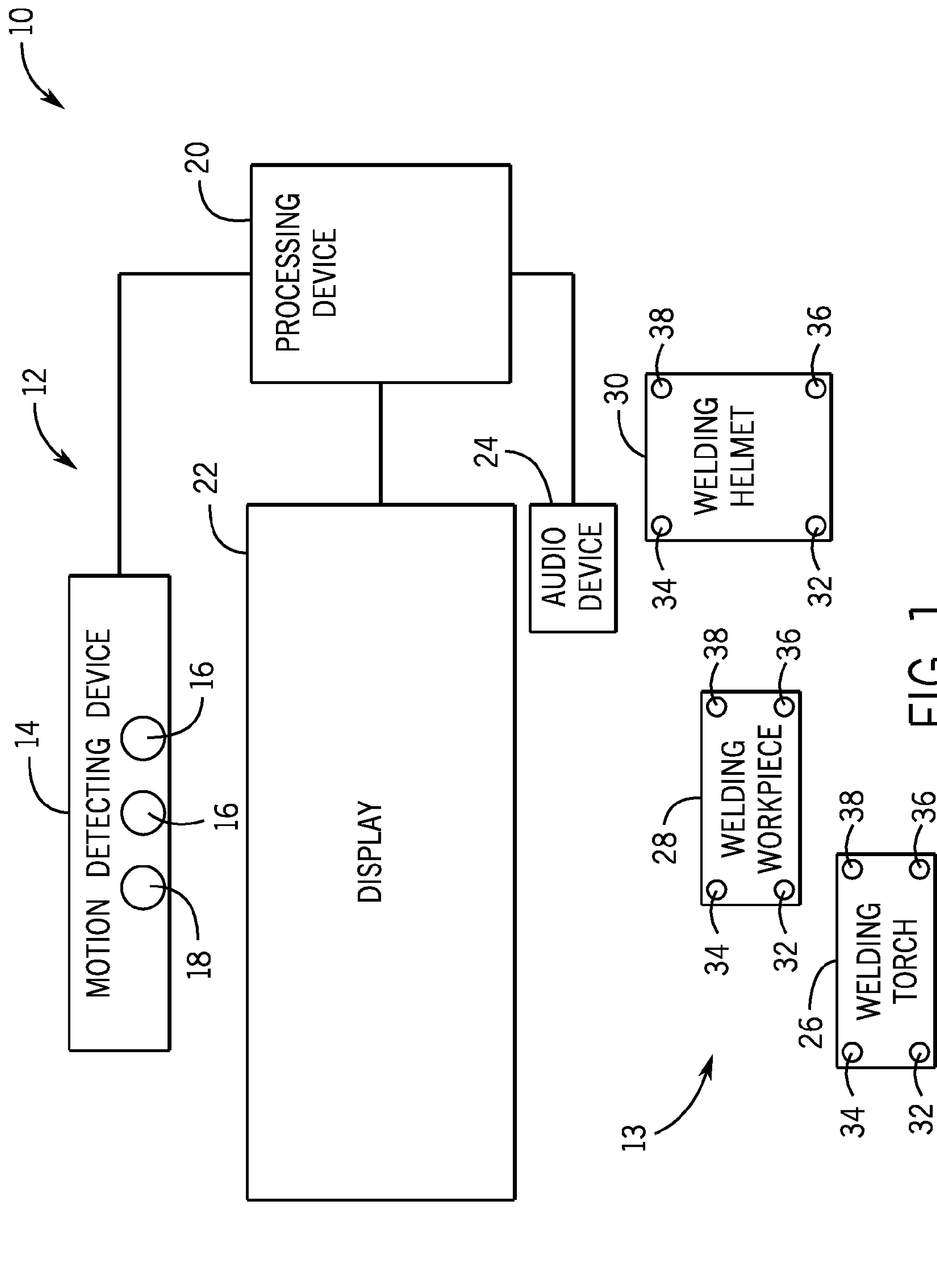

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MOTION DETECTING DEVICE
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DISPLAY
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AUDIO DEVICE
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WELDING HELMET
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FIG. 1

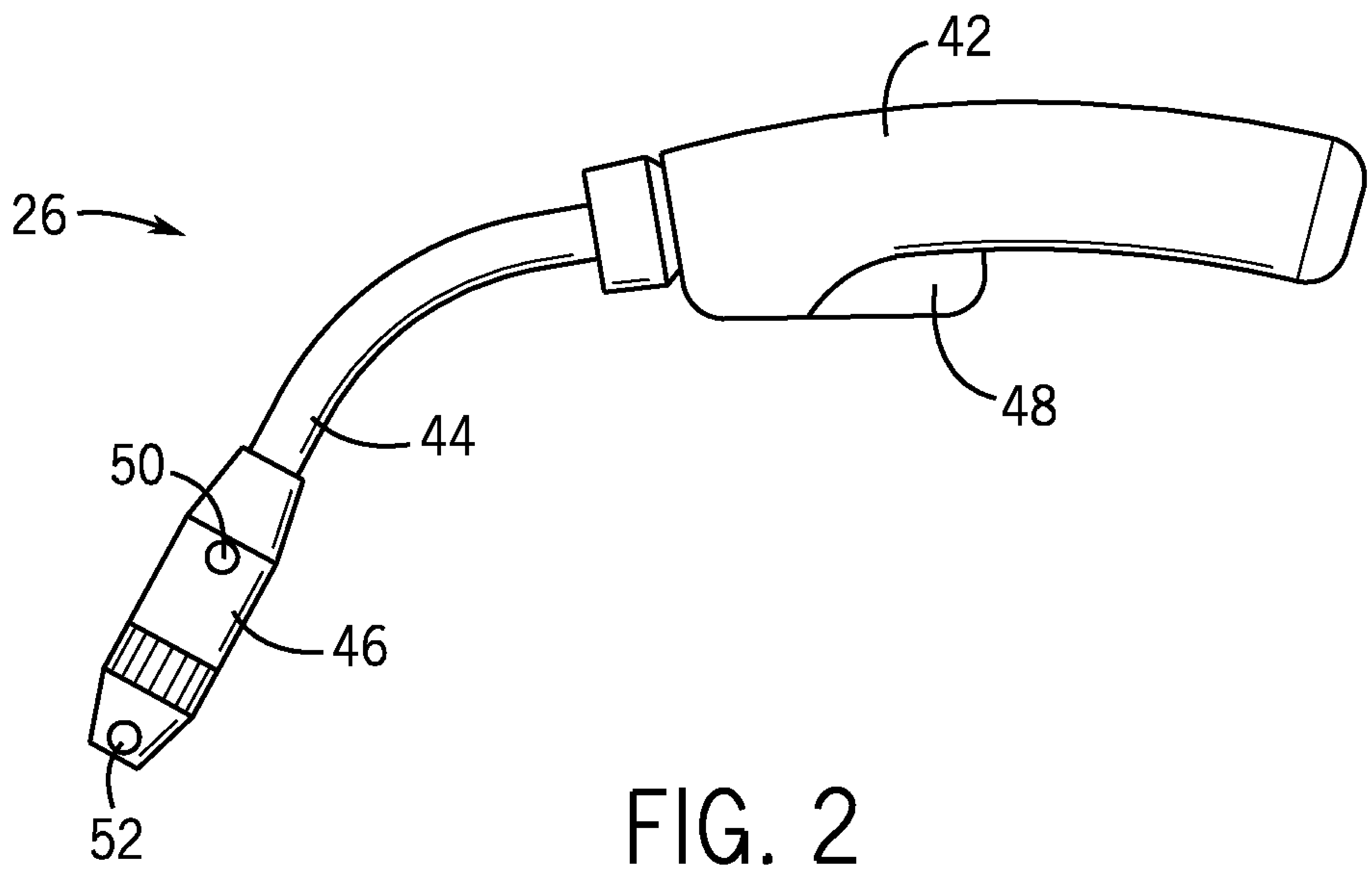
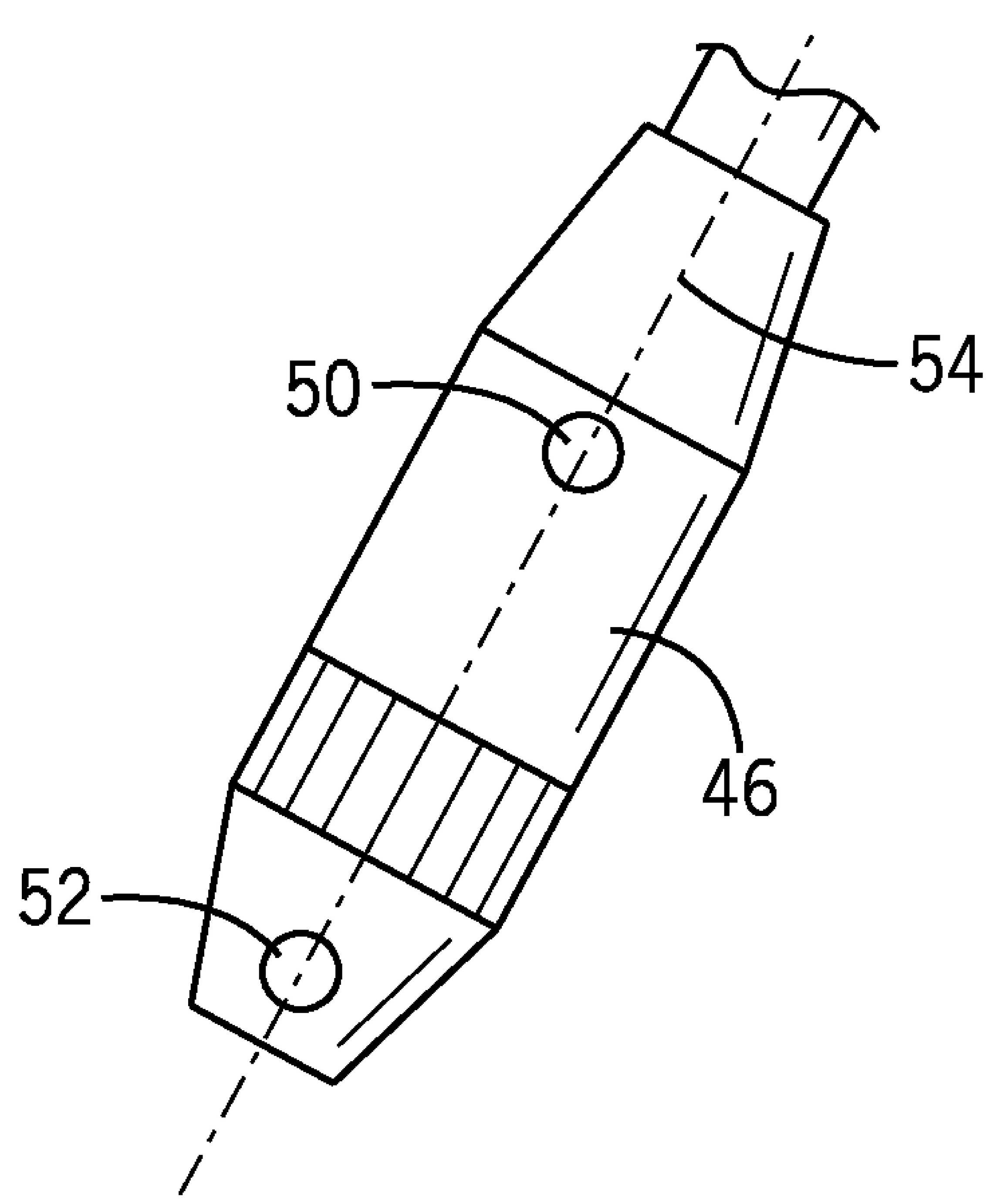


FIG. 2



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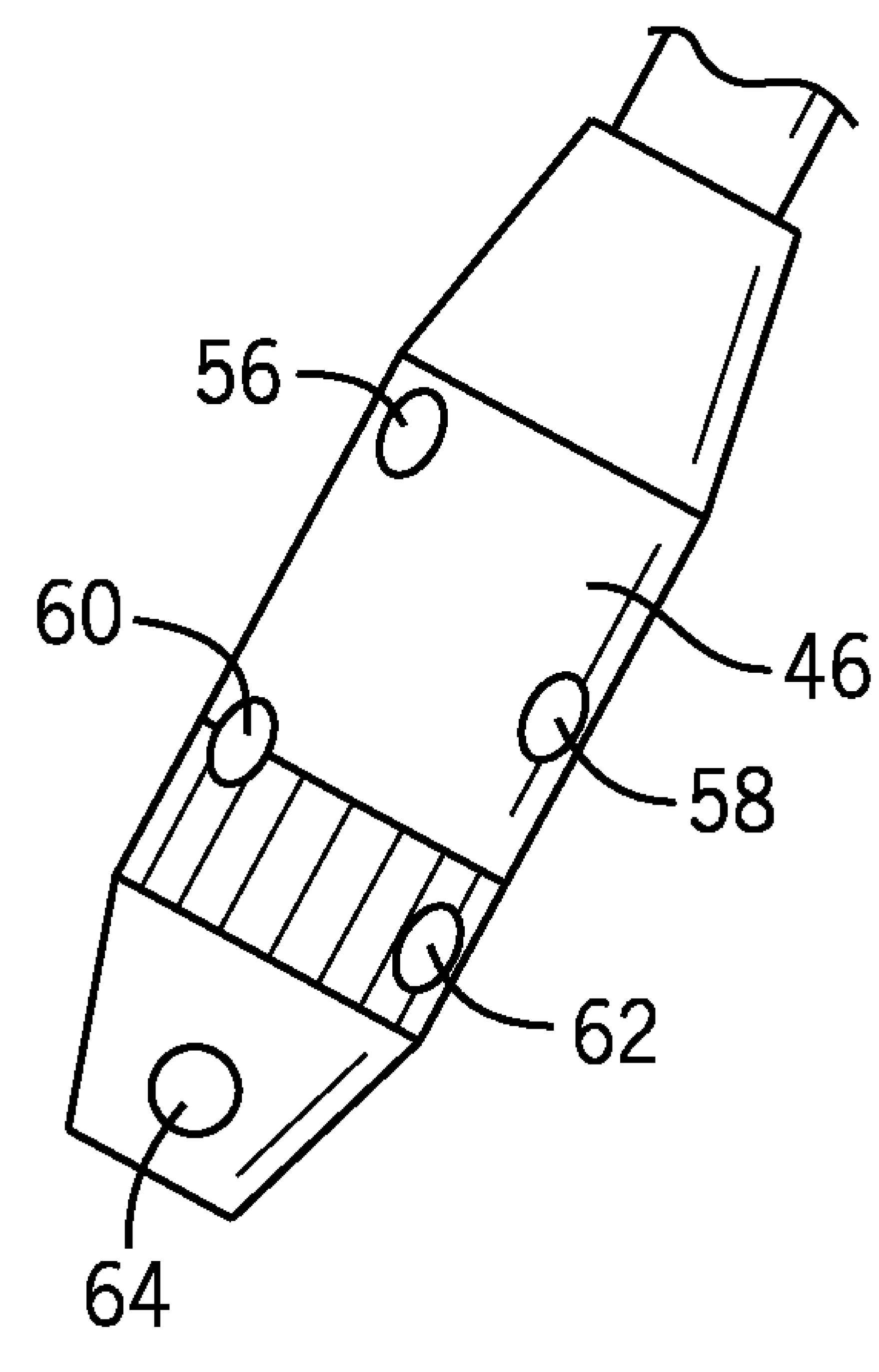


FIG. 4

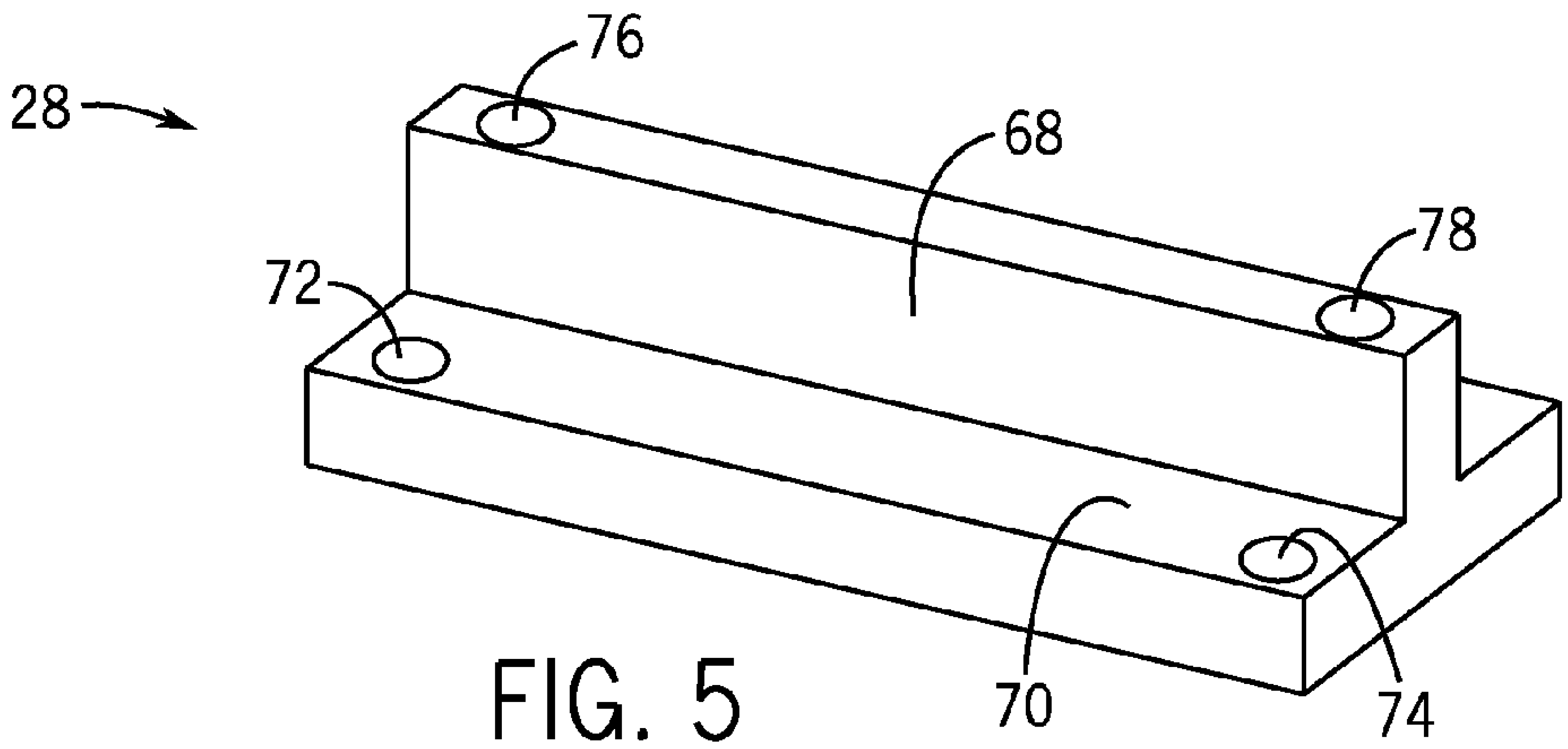
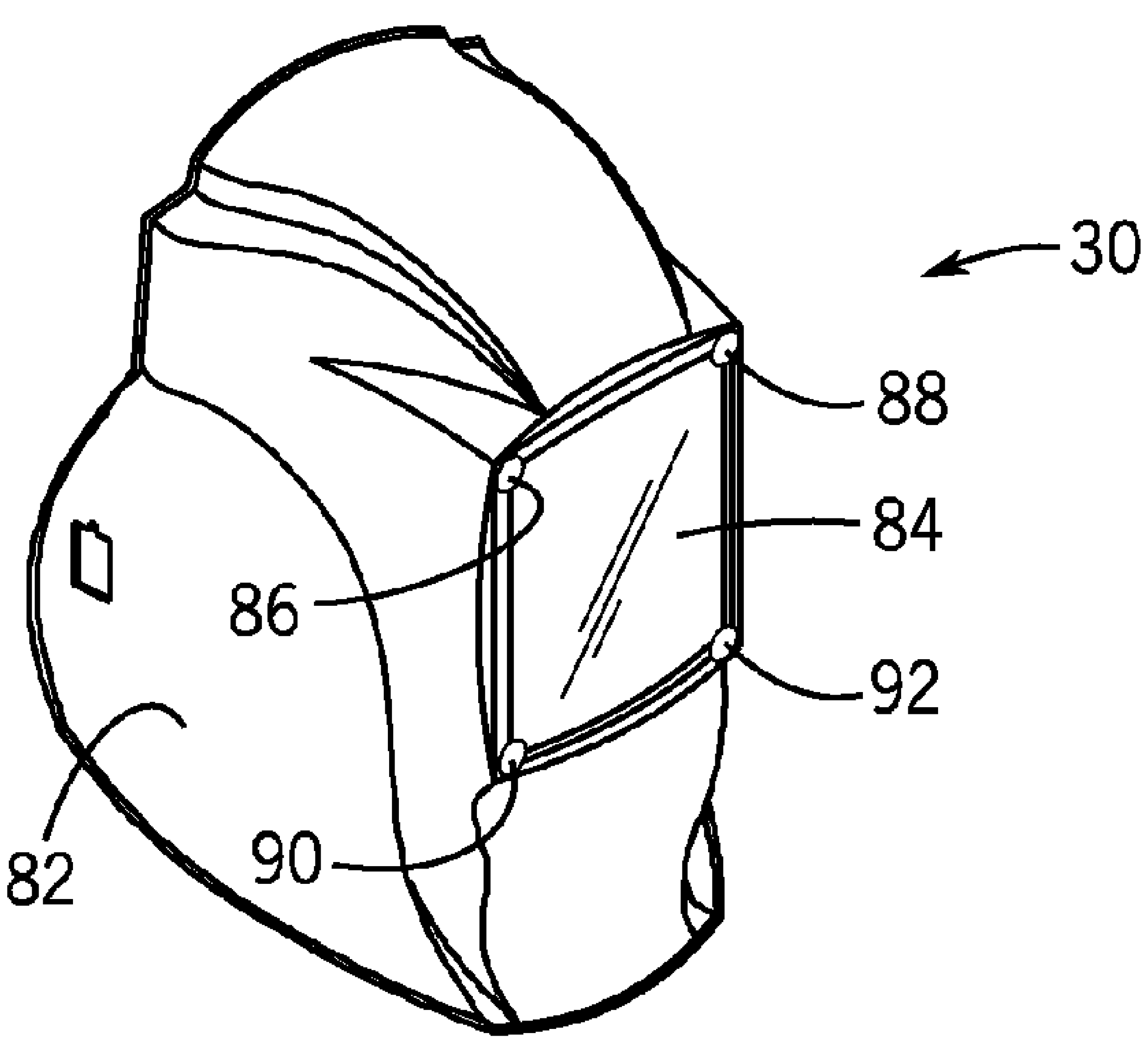


FIG. 5

FIG. 6



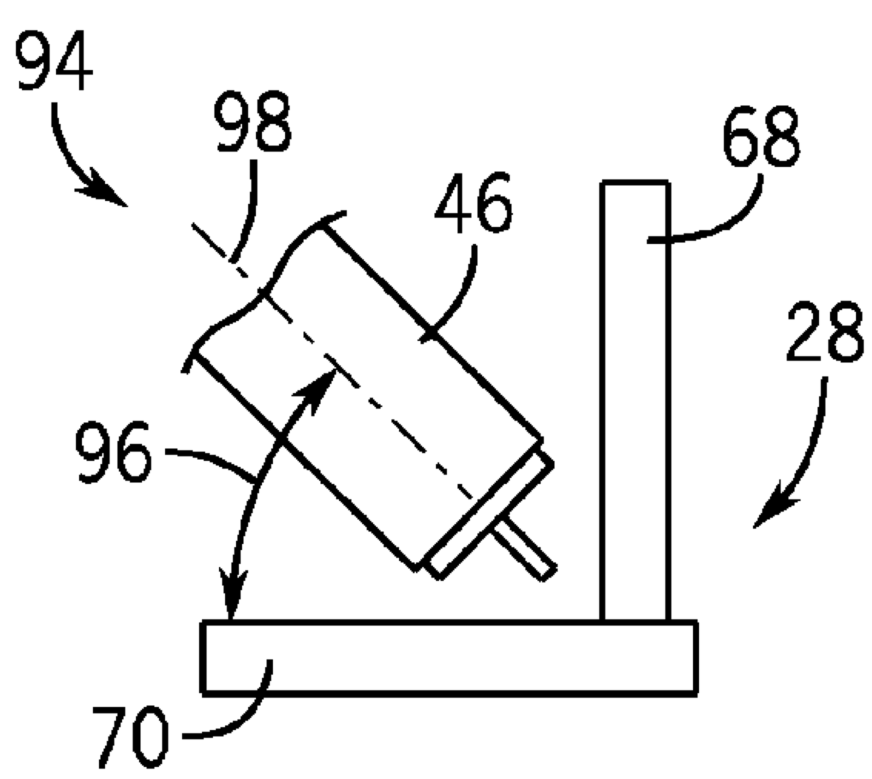


FIG. 7

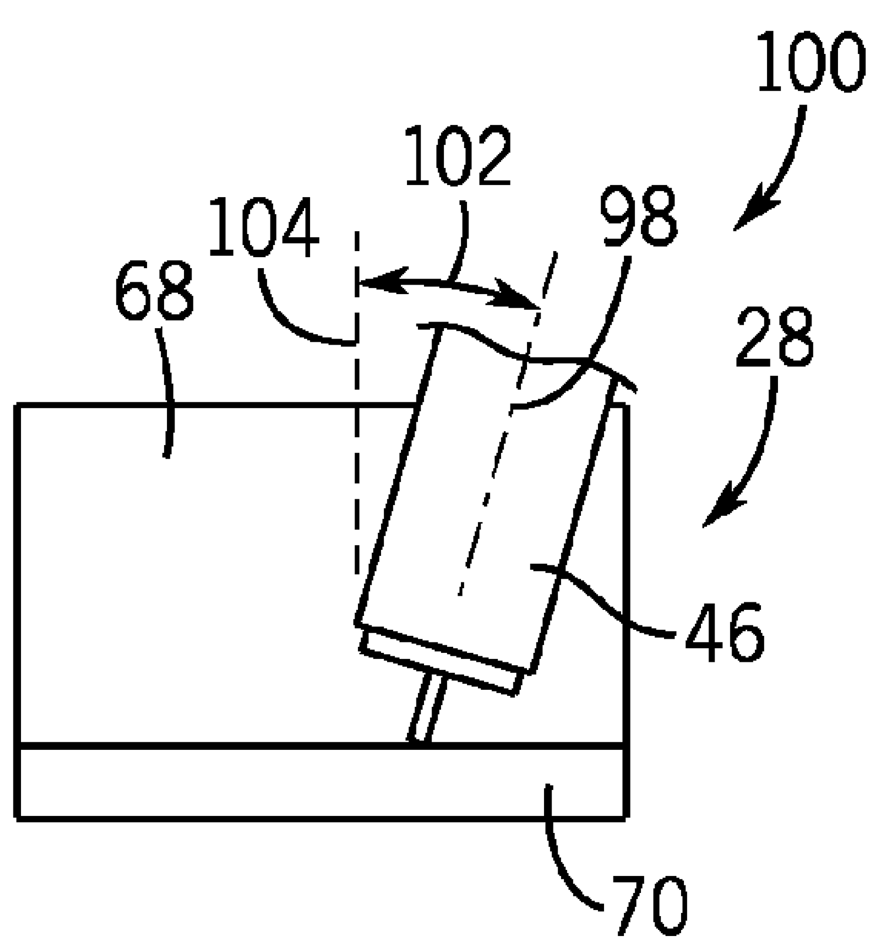


FIG. 8

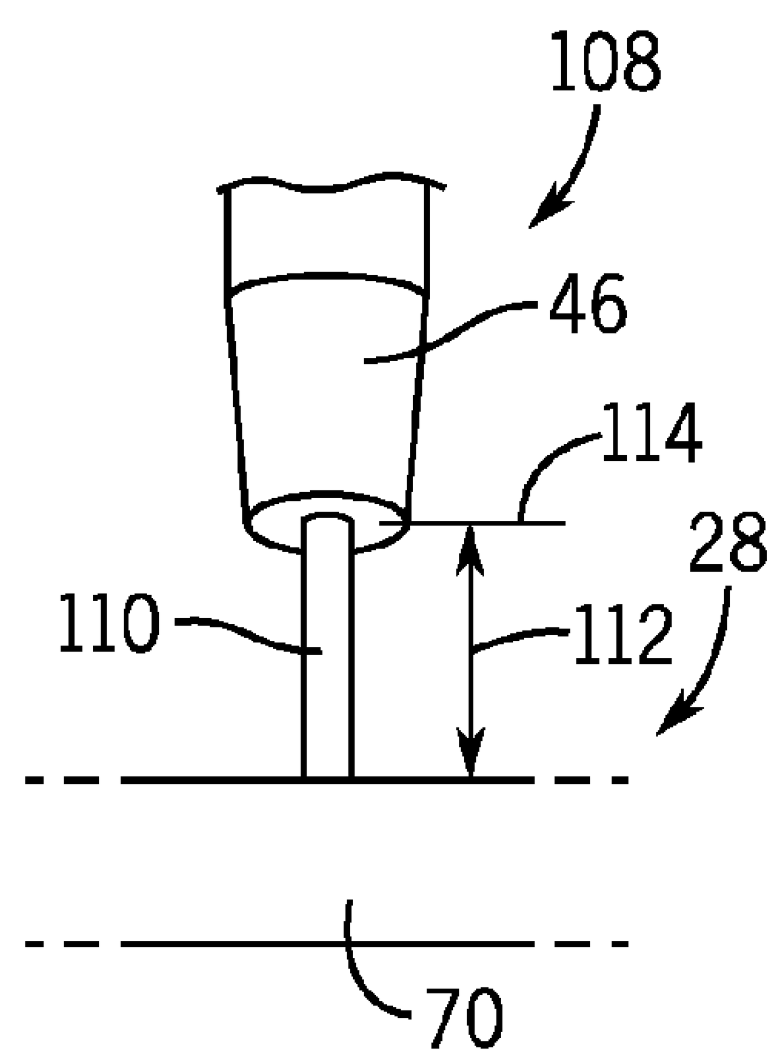


FIG. 9

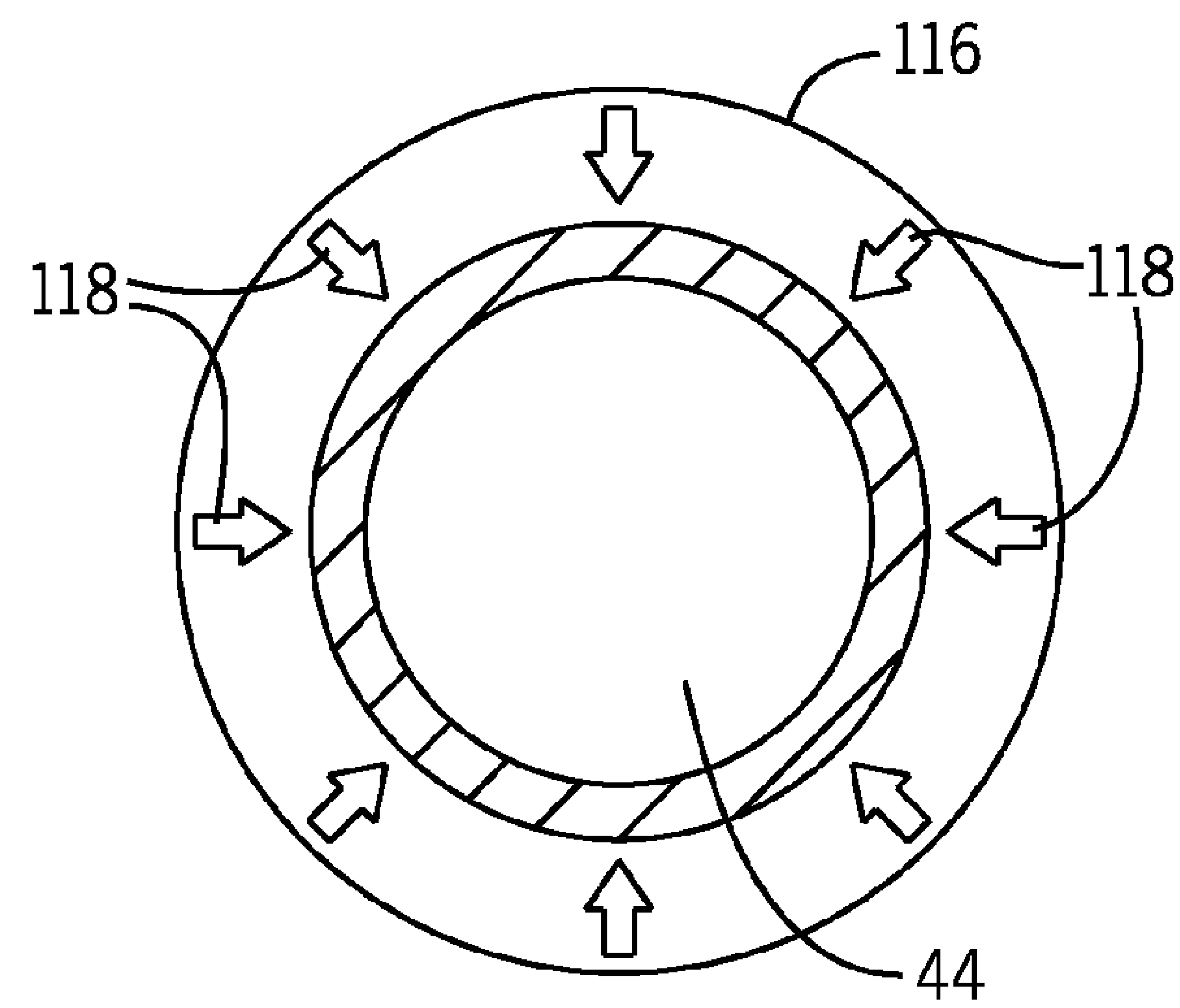


FIG. 10A

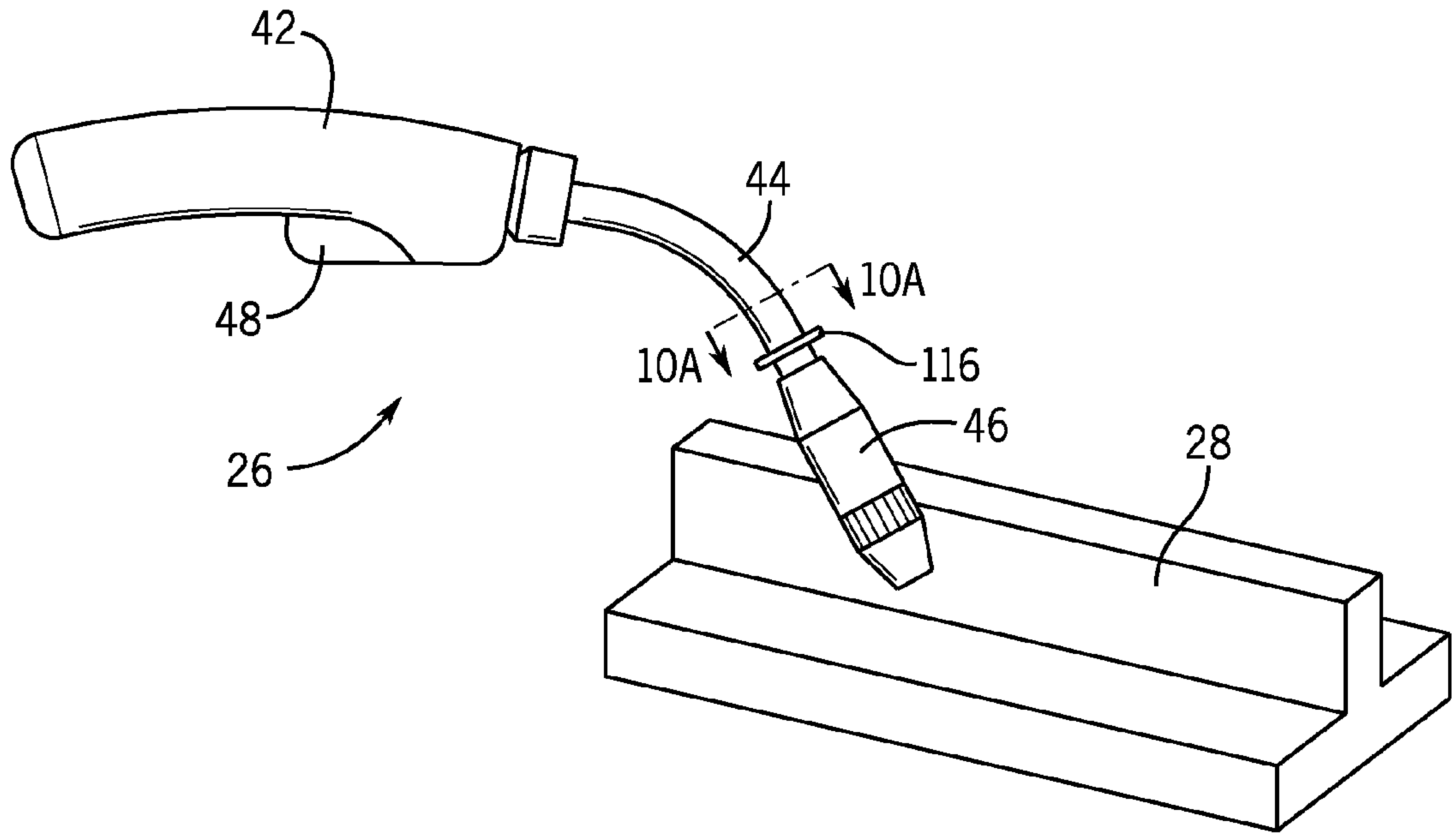


FIG. 10

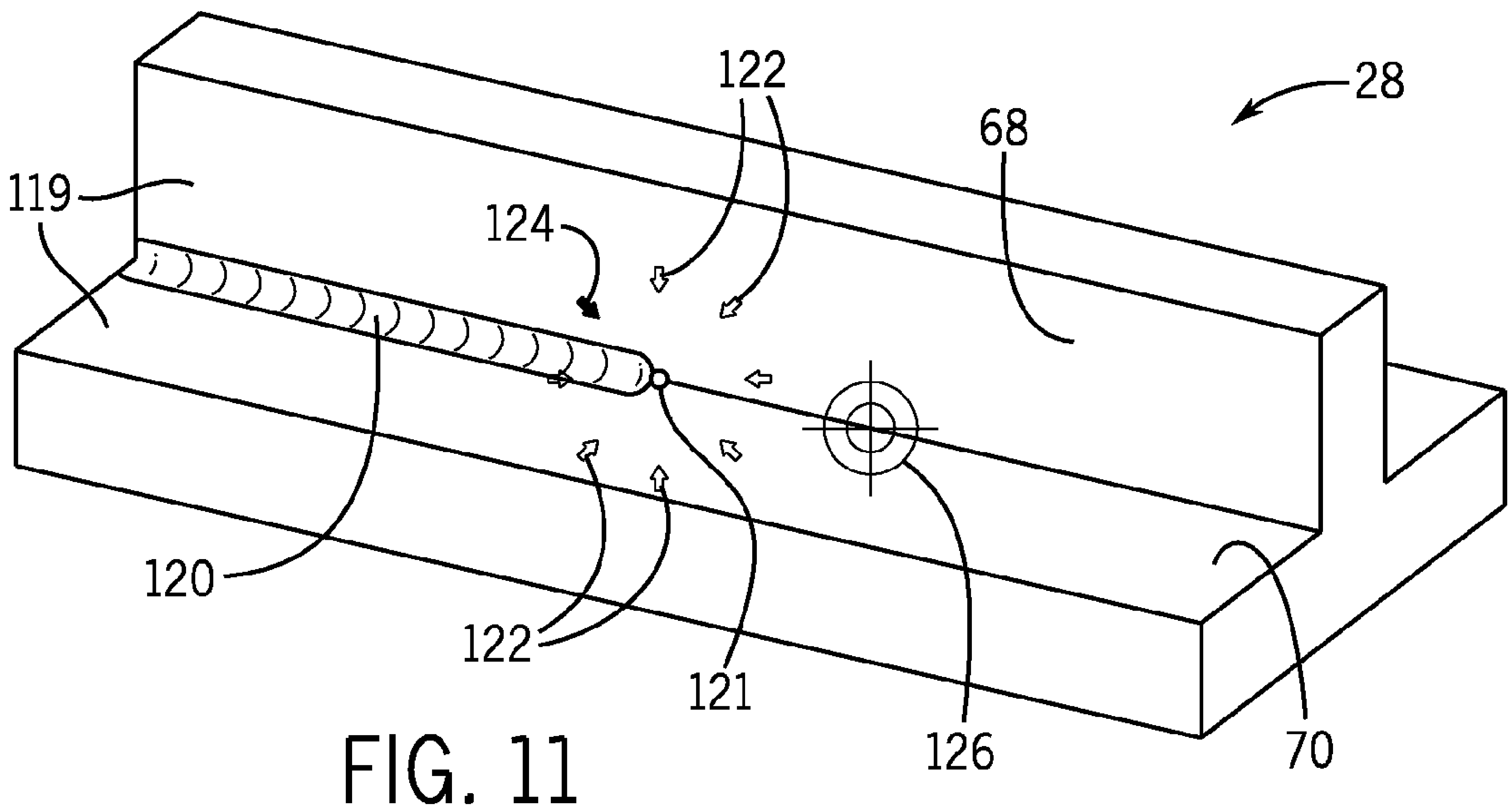

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FIG. 11

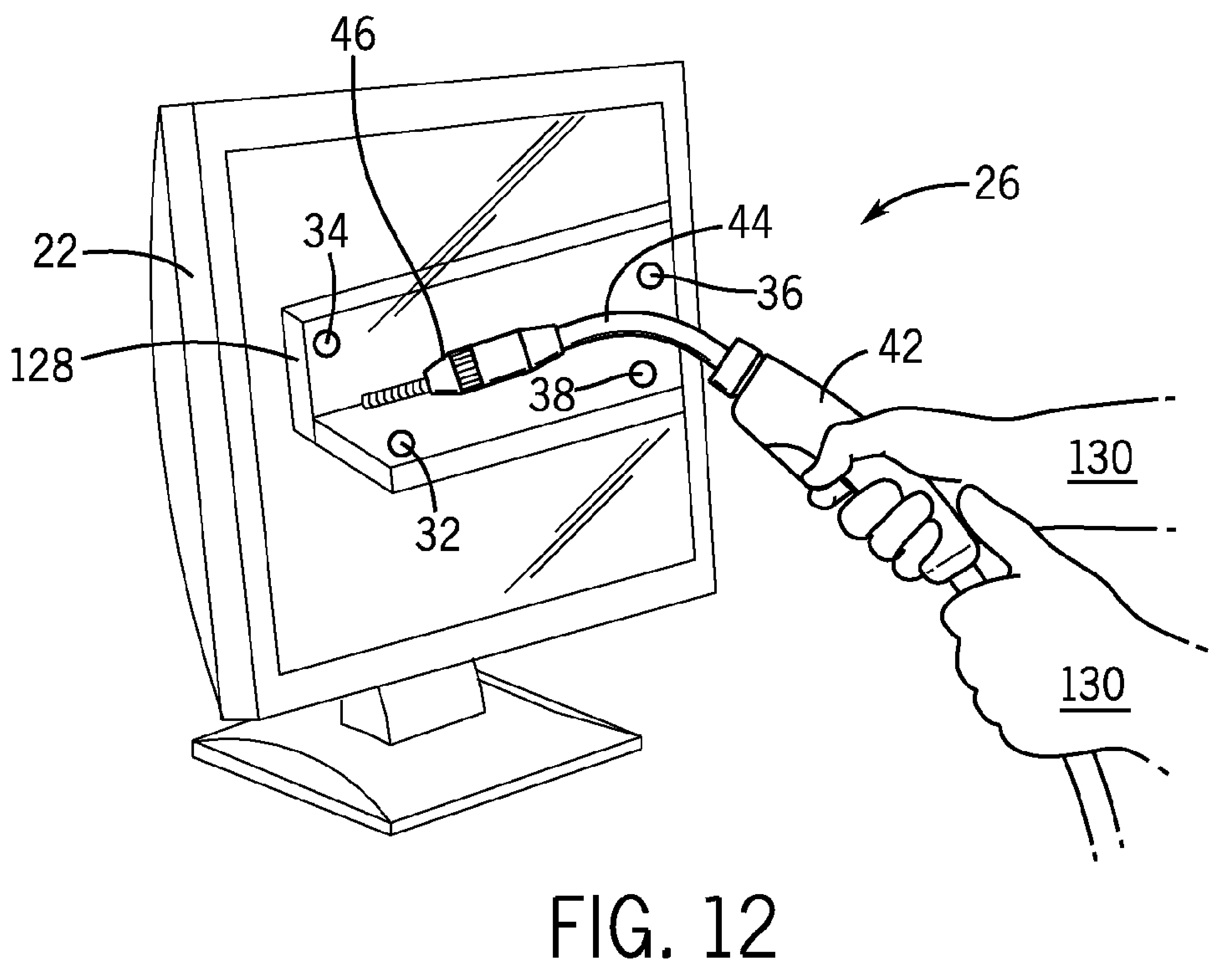
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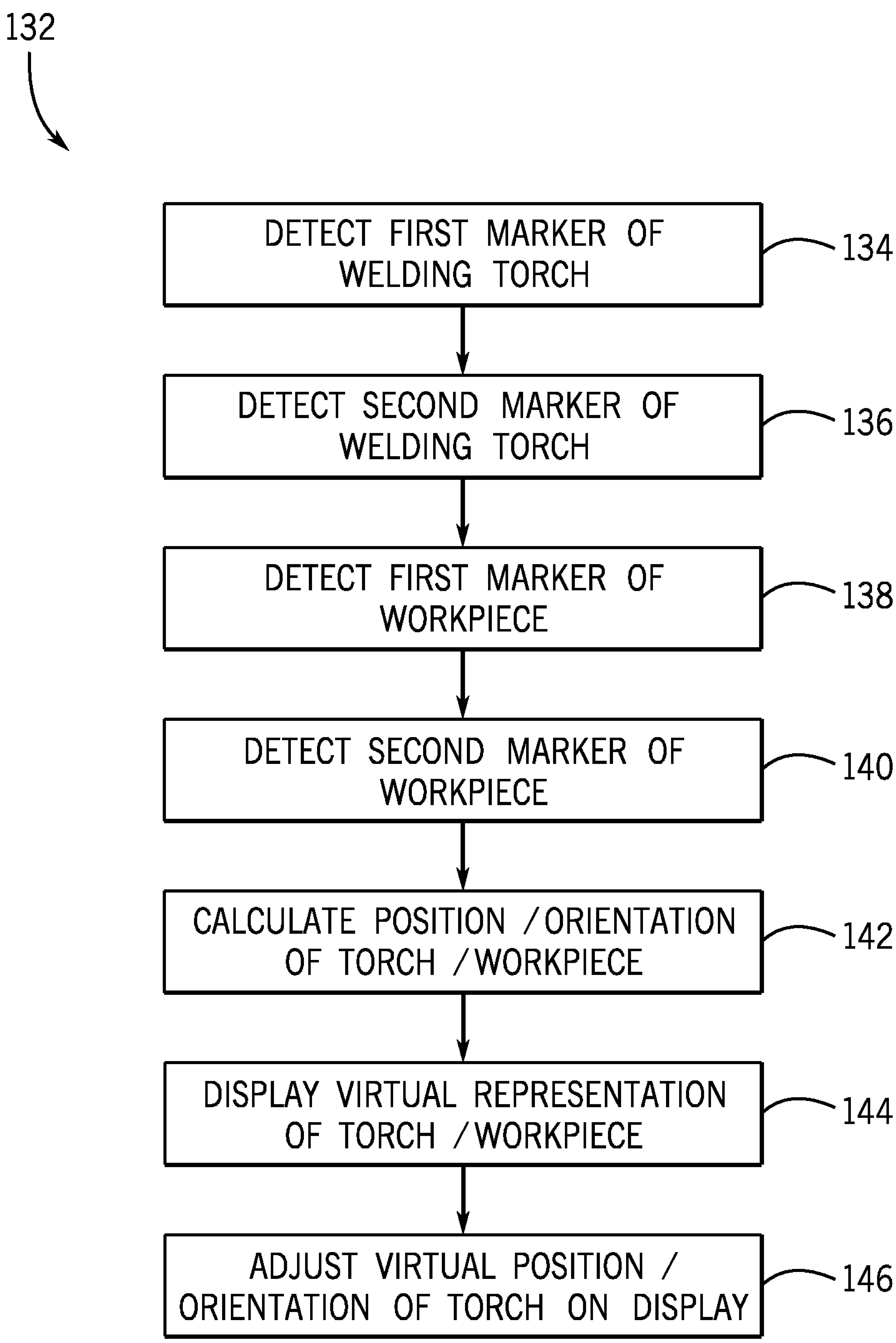
FIG. 12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DETECT SECOND MARKER OF WELDING TORCH
136
DETECT FIRST MARKER OF WORKPIECE
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DETECT SECOND MARKER OF WORKPIECE
140
CALCULATE POSITION /ORIENTATION OF TORCH /WORKPIECE
142
DISPLAY VIRTUAL REPRESENTATION OF TORCH /WORKPIECE
144
ADJUST VIRTUAL POSITION / ORIENTATION OF TORCH ON DISPLAY
146

FIG. 13

SYSTEM AND DEVICE FOR WELDING TRAINING

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Non provisional U.S. Patent Application of U.S. Provisional Application No. 61/724,322, entitled "System and Device for Welding Training", filed Nov. 9, 2012, which is hereby incorporated by reference in its entirety.

BACKGROUND

The invention relates generally to welding and, more particularly, to a system and device for welding training.

Welding is a process that has increasingly become utilized in various industries and applications. Such processes may be automated in certain contexts, although a large number of applications continue to exist for manual welding operations. In both cases, such welding operations rely on a variety of types of equipment to ensure the supply of welding consumables (e.g., wire feed, shielding gas, etc.) is provided to the weld in appropriate amounts at the desired time.

To perform manual welding operations, welding operators may be trained using a welding training system. The welding training system may be designed to train welding operators the proper techniques for performing various welding operations. Certain welding training systems may use virtual reality, augmented reality, or other training methods. As may be appreciated, these training systems may be expensive to acquire. Accordingly, welding training institutions may acquire a limited number of such training systems. Therefore, welding operators being trained by the welding training institutions may have a limited amount of time for hands-on training using the training systems.

BRIEF DESCRIPTION

In one embodiment, a welding training system includes a position detecting system configured to detect a distance between the position detecting system and objects within a field of view of the position detecting system, and to produce a map corresponding to the objects. The welding training system also includes markers configured to be coupled to a device of the welding training system. Furthermore, the markers are configured to be detected by the position detecting system.

In another embodiment, a method for determining a position of a welding torch, an orientation of the welding torch, or some combination thereof, includes detecting a first marker of the welding torch using a position detecting system. The position detecting system is configured to detect a distance between the position detecting system and objects within a field of view of the position detecting system, and to produce a map corresponding to the objects. The method also includes detecting a second marker of the welding torch using the position detecting system and calculating the position of the welding torch, the orientation of the welding torch, or some combination thereof, using the detected first and second markers.

In another embodiment, a method for determining a position, an orientation, or some combination thereof, of a welding torch and a welding workpiece includes detecting a first marker of the welding torch using a position detecting system. The position detecting system is configured to detect a distance between the position detecting system and objects within a field of view of the position detecting system, and to produce a map corresponding to the objects. The method also includes detecting a second marker of the welding torch using the position detecting system. The method includes detecting a first marker of the welding workpiece using the position detecting system and detecting a second marker of the welding workpiece using the position detecting system. The method also includes calculating the position, the orientation, or some combination thereof, of the welding torch and the welding workpiece using the first and second markers of the welding torch and the first and second markers of the welding workpiece.

DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

FIG. **1** is a block diagram of an embodiment of a welding training system in accordance with aspects of the present disclosure;

FIG. **2** is a side view of an embodiment of a welding torch configured to be used in the welding training system of FIG. **1** in accordance with aspects of the present disclosure;

FIG. **3** is a side view of an embodiment of a nozzle of the welding torch of FIG. **2** with an orientation axis determined in accordance with aspects of the present disclosure;

FIG. **4** is a side view of an embodiment of a nozzle of the welding torch of FIG. **2** having markers positioned around the nozzle in accordance with aspects of the present disclosure;

FIG. **5** is a perspective view of an embodiment of a workpiece configured to be used in the welding training system of FIG. **1** in accordance with aspects of the present disclosure;

FIG. **6** is a perspective view of an embodiment of a welding helmet configured to be used in the welding training system of FIG. **1** in accordance with aspects of the present disclosure;

FIG. **7** is an illustration of a work angle of a welding operation in accordance with aspects of the present disclosure;

FIG. **8** is an illustration of a travel angle of a welding operation in accordance with aspects of the present disclosure;

FIG. **9** is an illustration of a contact tip-to-work distance of a welding operation in accordance with aspects of the present disclosure;

FIG. **10** is a perspective view of a welding torch having a welding guidance indicator in accordance with aspects of the present disclosure;

FIG. **10**A is a top view of the welding guidance indicator of FIG. **10** in accordance with aspects of the present disclosure;

FIG. **11** is a perspective view of an embodiment of a workpiece having a display to provide guidance to a welding operator in accordance with aspects of the present disclosure;

FIG. **12** is a perspective view of an embodiment of a virtual workpiece in accordance with aspects of the present disclosure; and

FIG. **13** is an embodiment of a method for determining a position and an orientation of a welding torch and a workpiece in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

FIG. **1** is a block diagram of an embodiment of a welding training system **10**. The welding training system **10** includes a detection system **12** and a welding system **13**. As illustrated, the detection system **12** includes a motion detecting device **14** (e.g., a three-dimensional motion or position detecting device) that is used to detect position, orientation, and/or motion of objects in the vicinity of the welding system **13**. The motion detecting device **14** may be configured to detect a distance between the motion detecting device **14** and all objects within a field of view of the motion detecting device **14**. For example, the motion detecting device **14** may create a three-dimensional (3D) point cloud that maps a depth to each pixel of data received by a color camera of the motion detecting device **14**. Furthermore, a 3D coordinate (e.g., x, y, z) may be assigned to each pixel. As may be appreciated, the motion detecting device **14** may use any suitable devices to detect the positioning and motion of the objects in the vicinity of the welding system **13**. For example, in certain embodiments, the motion detecting device **14** includes built-in cameras **16** and an infrared emitter **18** that are used to determine a position and/or an orientation of devices in the welding system **13** (e.g., relative to the motion detecting device **14**). In certain embodiments, the build-in cameras **16** include an RGB camera and an infrared camera. As may be appreciated, an RGB camera may be configured to detect three basic color components (e.g., red, green, blue) such that the detected three basic color components may be used to form an image. Furthermore, an infrared camera may be configured to detect infrared radiation such that the detected infrared radiation may be used to form an image. It should be noted that the motion detecting device **14** may be a commercially off-the-shelf (COTS) product available for consumer purchase. For example, the motion detecting device **14** may be a Kinect™ by Microsoft Corporation of Redmond, Wash., or a Leap device by Leap Motion of San Francisco, Calif. In addition, the motion detecting device **14** may be a computer accessory, or may be part of a video game system. Although only one motion detecting device **14** is illustrated in FIG. **1**, in certain embodiments, multiple motion detecting devices **14** may be used to improve detection capabilities.

A processing device **20** (e.g., central processing unit) of the detection system **12** may be coupled to the motion detecting device **14** and may be configured to process data from the motion detecting device **14**. For example, the processing device **20** may be configured to receive data from the cameras **16** and determine a position and/or an orientation of one or more detected objects based on the data. The processing device **20** may be coupled to a display **22** (e.g., tablet, touchscreen, monitor, etc.), on which images corresponding to the detected objects may be displayed. Furthermore, the processing device **20** may be coupled to an audio device **24** (e.g., speaker, microphone, etc) for providing an audio output and/or receiving an audio input.

The welding system **13** includes one or more welding devices **26**, **28**, and **30** that are configured to be detected by the motion detecting device **14** of the detection system **12**. As may be appreciated, each of the welding devices **26**, **28**, and **30** may be any suitable welding device. For example, the welding devices **26**, **28**, and **30** may include a welding torch **26**, a welding workpiece **28**, a welding helmet **30**, and so forth. As illustrated, each of the welding devices **26**, **28**, and **30** includes markers **32**, **34**, **36**, and **38** that are configured to be detected by the motion detecting device **14**. Although the markers **32**, **34**, **36**, and **38** are illustrated in FIG. **1** as being generally circular, the markers **32**, **34**, **36**, and **38** may be any suitable shape (e.g., square, rectangle, star, parallelogram, trapezoid, hexagon, etc.). Furthermore, the markers **32**, **34**, **36**, and **38** may be any suitable size and any suitable color. As may be appreciated, the shape, the size, and/or the color of each marker **32**, **34**, **36**, and **38** may be different. Accordingly, the markers **32**, **34**, **36**, and **38** may be configured in any suitable manner to allow the motion detecting device **14** to distinguish between the markers **32**, **34**, **36**, and **38** in order to determine the position and/or the orientation of the welding devices **26**, **28**, and **30**. For example, an RGB camera of the motion detecting device **14** may be used to detect markers **32**, **34**, **36**, and **38** where each marker has a different color. The markers **32**, **34**, **36**, and **38** may include light-emitting diodes (LEDs) (or some other device configured to be illuminated), stickers, indentions, protrusions, molded components, printed components, covers, lenses, and so forth. For example, in certain embodiments, one or more of the markers **32**, **34**, **36**, and **38** may include a cover or lens disposed over an LED. Moreover, the covers or lenses may have different shapes, sizes, and/or colors, while LEDs disposed under the covers or lenses may not have different shapes, sizes, and/or colors. In some embodiments, the welding devices **26**, **28**, and **30** may be manufactured with the markers **32**, **34**, **36**, and **38**. Moreover, in other embodiments, the markers **32**, **34**, **36**, and **38** may be coupled to the welding devices **26**, **28**, and **30** at any time after the welding devices are manufactured. For example, the markers **32**, **34**, **36**, and **38** may be sold separately from the welding devices **26**, **28**, and **30**. Accordingly, the markers **32**, **34**, **36**, and **38** may be attached to the welding devices **26**, **28**, and **30** by an operator. In certain embodiments, the welding devices **26**, **28**, and **30** may be configured so that they do not provide an electrical signal to the motion detecting device **14** (e.g., they may be configured as passive devices such that the motion, position, and/or orientation of the welding devices **26**, **28**, and **30** are detected solely by the motion detecting device **14** without the welding devices **26**, **28**, and **30** transmitting any signals to the motion detecting device **14**). However, in such embodiments, the welding devices **26**, **28**, and **30** may still provide data to the detection system **12** that is not related to position and/or orientation (e.g., usage time, user identification, welding training initialization, welding training completion, and so forth). For example, the trigger of the welding torch **26** may be connected to the processing device **20** to indicate start and/or stop (e.g., wired, such as via a universal serial bus (USB) connection, and/or wireless).

As may be appreciated, a welding training system **10** that uses COTS products may be considerably less expensive than a welding training system **10** that does not use COTS products. Accordingly, the welding training system **10** described herein may provide a cost savings to an establishment that trains welding operators. Furthermore, due to the low cost of the welding training systems **10** described herein, an establishment that provides welding training may be able to provide multiple welding training systems **10** to allow welding operators being trained to have a greater amount of time to use the welding training systems **10**.

FIG. **2** is a side view of an embodiment of a welding torch **26** configured to be used in the welding training system **10** of FIG. **1**. As may be appreciated, the welding torch **26** may be an actual welding torch used to perform real welding operations, or a training welding torch. Accordingly, the welding torch **26** may be detected during an actual welding operation and/or a simulated welding operation. In the present embodiment, the welding torch **26** includes a handle **42**, a neck **44**, and a nozzle **46**. Furthermore, the handle **42** includes a trigger **48** for initiating a welding operation (e.g., either a real world welding operation or a simulated welding operation). As illustrated in FIG. **2**, the handle **42** is coupled to the nozzle **46** via the neck **44**. As may be appreciated, the neck **44** and the nozzle **46** may be considered "non-handle portions" of the welding torch **26**. The nozzle **46** includes markers **50** and **52** that are configured to be detected by the detection system **12**. In other embodiments, any suitable location on the welding torch **26** may include markers **50** and **52**. As may be appreciated, the markers **50** and **52** may be any suitable size, shape, and/or color for being detected by the detection system **12**. Accordingly, the detection system **12** may determine a position (e.g., x-axis, y-axis, and z-axis) of each marker **50** and **52** with respect to the motion detecting device **14** of the detection system **12**.

FIG. **3** is a side view of an embodiment of the nozzle **46** of the welding torch **26** of FIG. **2** with an orientation axis **54** (e.g., a longitudinal axis of the nozzle **46**). The orientation axis **54** may be determined by the detection system **12** using the markers **50** and **52**. For example, the detection system **12** may detect a position of each of the markers **50** and **52** (e.g., and therefore the position of the welding torch **26**) with respect to the motion detecting device **14** of the detection system **12**. Furthermore, the detection system **12** may determine the orientation (e.g., pitch, roll, and yaw) of the welding torch **26** by virtually connecting the markers **50** and **52** to form the orientation axis **54**.

FIG. **4** is a side view of an embodiment of the nozzle **46** of the welding torch **26** of FIG. **2** having markers **56**, **58**, **60**, **62**, and **64** positioned around the exterior of the nozzle **46**. As may be appreciated, the markers **56**, **58**, **60**, **62**, and **64** may be any suitable size, shape, and/or color for being detected by the detection system **12**. The markers **56**, **58**, **60**, **62**, and **64** are positioned around the nozzle **46** of the welding torch **26** so that when the welding torch **26** is moved to various positions, the nozzle **46** will still be in view of the detection system **12**. Accordingly, the position and/or the orientation of the welding torch **26** may be determined as the welding torch **26** is rotated around.

The position and/or the orientation of the welding torch **26** may be determined relative to a position and/or an orientation of a workpiece. Accordingly, in some embodiments, the workpiece may be positioned in a fixed position relative to the motion detecting device **14** of the detection system **12**. For example, the motion detecting device **14** and the workpiece may be positioned using a mechanical fixture to ensure that the motion detecting device **14** is at a predetermined position and/or orientation relative to the workpiece. In other embodiments, a predefined calibration procedure may be used to determine the position of the workpiece relative to the motion detecting device **14**. For example, the welding torch **26** may be touched to the workpiece at different locations to allow the detection system **12** to determine the position and/or the orientation of the workpiece based on the predefined calibration procedure. Furthermore, in certain embodiments, the detection system **12** may be configured to detect the position and/or the orientation of the workpiece using markers.

Accordingly, FIG. **5** is a perspective view of an embodiment of a workpiece **28** configured to be used in the welding training system **10** of FIG. **1**. In the illustrated embodiment, the workpiece **28** includes a vertical portion **68** and a horizontal portion **70** to be welded together (e.g., either in a real world or a virtual welding operation). As illustrated, a first set of markers **72** and **74** are positioned on the horizontal portion **70**, while a second set of markers **76** and **78** are positioned on the vertical portion **68**. Again, the markers **72**, **74**, **76**, and **78** may be any suitable size, shape, and/or color for being detected by the detection system **12**. Accordingly, the detection system **12** may determine a position (e.g., x-axis, y-axis, and z-axis) of each marker **72**, **74**, **76**, and **78** of the workpiece **28**. Furthermore, the detection system **12** may determine both a position and an orientation of the workpiece **28**. With the position and orientation of the workpiece **28**, the detection system **12** may determine the position and/or the orientation of the welding torch **26** (e.g., as described above with respect to FIGS. **2-4**) relative to the workpiece **28**. Although the workpiece **28** is configured for performing a tee joint, the workpiece **28** may be configured to perform a butt joint, a lap joint, or any other suitable configuration. Furthermore, the workpiece **28** may be configured for welding in any suitable orientation (e.g., flat, horizontal, vertical, overhead, etc.) and/or using any suitable welding technique (e.g., weaving, stitching, etc.).

FIG. **6** is a perspective view of an embodiment of a welding helmet **30** configured to be used in the welding training system **10** of FIG. **1**. The welding helmet **30** includes a helmet shell **82** and a lens assembly **84**. When worn by a welding operator, the helmet shell **82** covers the head of the operator. As may be appreciated, the welding operator views a welding operation through the lens assembly **84**. As illustrated, the welding helmet **30** includes markers **86**, **88**, **90**, and **92** of the welding helmet **30**. Again, like other markers previously described, the markers **86**, **88**, **90**, and **92** may be any suitable size, shape, and/or color for being detected by the detection system **12**. Accordingly, the detection system **12** may determine a position (e.g., x-axis, y-axis, and z-axis) of each marker **86**, **88**, **90**, and **92** of the welding helmet **30**. Furthermore, the detection system **12** may determine both a position and an orientation of the welding helmet **30**. With the position and orientation of the welding helmet **30**, the detection system **12** may determine the position and/or the orientation of the welding torch **26** (e.g., as described above with respect to FIGS. **2-4**) relative to the welding helmet **30**. In addition, the detection system **12** may track the movement of the welding helmet **30** during a welding operation. Data from the detection system **12** may be displayed within the welding helmet **30**. For example, data may be incorporated within a heads-up display of the helmet **30**. The position of the helmet **30** may be associated with the position of the welding workpiece **28** and the welding torch **26**. Images corresponding to the association may also be displayed. In certain embodiments a type of safety glasses may incorporate a camera and/or a display for capturing and/or displaying image data.

By detecting the position and the orientation of the welding torch **26** relative to the workpiece **28**, a work angle (e.g., roll), a travel angle (e.g., pitch), a contact tip-to-work distance (CTWD), and/or a travel speed of the welding torch **26** may be determined For example, FIG. **7** is an illustration of a work angle **94** of a welding operation. As illustrated, the work angle **94** is an angle **96** between the horizontal portion **70** of the workpiece **28** and a central axis **98** (e.g., this may be similar to the axis **54** described above) of the welding torch **26** as viewed from the side of the workpiece **28**. As another example, FIG. **8** is an illustration of a travel angle **100** of a welding operation. The travel angle **100** is an angle **102** between the central axis **98** of the welding torch **26** and a vertical axis **104** of the vertical portion **68** of the workpiece

28. As illustrated, the vertical axis **104** extends parallel to the vertical portion **68** of the workpiece **28**. Furthermore, the travel angle **100** is determined relative to a front view of the workpiece **28**. As a further example, FIG. **9** is an illustration of a CTWD **108** of a welding operation. As illustrated, a welding electrode or welding wire **110** extends from the nozzle **46** of the welding torch **26**. The CTWD **108** is a distance **112** between an upper surface of the horizontal portion **70** and a position **114** of the tip of the nozzle **46** of the welding torch **26**.

As may be appreciated, welding data (e.g., the work angle, the travel angle, the CTWD, and/or the travel speed, among other data) may be provided by the welding training system **10** of FIG. **1** to a welding operator, instructor, and/or a supervisor during a welding operation (e.g., real or simulated). Furthermore, such welding data may be provided to the welding operator, instructor, and/or the supervisor after completion of the welding operation. In certain embodiments, the welding data may be provided on the display **22** of the detection system **12** in any suitable format (e.g., a welding score, charts, graphs, etc.) and/or to the audio device **24** of the detection system **12**. Furthermore, a video playback of the welding operation (e.g., a three-dimensional rendering of the welding torch **26** as it moves along the workpiece **28**, a virtual arc, a bead, and so forth) may be displayed on the display **22** of the detection system **12**. In other embodiments, the welding operator may view welding data and/or three-dimensional rendering via a heads up display (e.g., in the welding helmet **30**) or via virtual reality glasses. Accordingly, the welding operator may receive visual and/or audio clues to help them improve their welding technique. In certain embodiments, welding data may be provided (e.g., via a network) from multiple welding training systems **10** to a central location where the welding data from multiple welding training systems **10** may be compared (e.g., to compare performance of different welding operators).

In some embodiments, welding data output from the detection system **12** may provide the welding operator with a welding score. Furthermore, the welding data may be used as part of a welding game (e.g., a welding game software program executed by the processing device **20** of the detection system **12** and displayed on the display **22** of the detection system **12**). For example, the welding data may be used to provide the welding operator with points that accumulate with each properly performed weld. In some embodiments, a simulated welding technique of the welding operator may be applied to a real world welding application. For example, the simulated welding technique might be applied to a chassis of a virtual racecar. After one or more simulated welds have been completed, the virtual racecar may be driven in a simulated race (e.g., on a racetrack) to see how the structure of the racecar handles environmental stresses (e.g., to test the structural integrity of the simulated welds). In certain embodiments, the virtual racecar may be controlled by the welding operator, or the virtual racecar may operate in an automated race that the welding operator may observe. Furthermore, the virtual racecar may compete against other virtual racecars (e.g., via a network) that have simulated welds performed by other welding operators to see how the virtual cars perform against each other.

In addition, in certain embodiments, the welding torch **26** may include built-in indicators to provide guidance to a welding operator. For example, FIG. **10** is a perspective view of the welding torch **26** having a welding guidance indicator **116** (e.g., display) to provide torch angle guidance (e.g., work angle guidance, travel angle guidance) and/or travel speed guidance. Furthermore, FIG. **10**A is a top view of the welding guidance indicator **116** of FIG. **10**. As illustrated, the welding guidance indicator **116** may include multiple outputs **118** (e.g., arrows) that may act as guides for the welding operator. For example, one or more of the outputs **118** may illuminate to direct the welding operator to change the torch angle. In certain embodiments, when none (or all) of the outputs **118** are illuminated, the welding operator may be holding the welding torch **26** at a proper torch angle. As may be appreciated, the outputs **118** may flash at various speeds to indicate to the welding operator to increase and/or slow down travel speed.

Furthermore, in certain embodiments, the workpiece **28** may include a display to provide guidance to a welding operator. Accordingly, FIG. **11** is a perspective view of an embodiment of the workpiece **28** having a display **119**. As illustrated, the display **119** may extend on surfaces of both the vertical portion **68** and the horizontal portion **70**. As a welding operator performs a virtual welding operation, a virtual weld bead **120** may be shown on the display **119**. Furthermore, a virtual welding arc **121** may be displayed on the display **119**. As illustrated, the display **119** may also include outputs **122** (e.g., arrows) that may direct the welding operator. For example, one or more of the outputs **122** may illuminate (e.g., output **124**) to direct the welding operator to change their torch angle. In certain embodiments, when none (or all) of the outputs **122** are illuminated on the display **119**, the welding operator may be holding the welding torch **26** at a proper torch angle. As may be appreciated, in some embodiments, the outputs **122** may flash at various speeds on the display **119** to indicate to the welding operator to increase and/or slow down travel speed. Furthermore, a target position **126** (e.g., crosshairs target) may be displayed on the display **119** to illustrate where the virtual weld bead **120** should be if the travel speed of the welding torch **26** were correct.

In certain embodiments, the workpiece **28** may be a virtual workpiece and may therefore be incorporated into the display **22** of the detection system **12**. Accordingly, FIG. **12** is a perspective view of an embodiment of a virtual workpiece **128** shown on the display **22** of the detection system **12**. In certain embodiments, the virtual workpiece **128** may include markers **32**, **34**, **36**, and **38** (e.g., virtual markers) configured to be detected by the motion detecting device **14**. As illustrated, a welding operator **130** may hold the welding torch **26** up to the display **22** to perform a virtual weld on the virtual workpiece **128**. As may be appreciated, the display **22** may be any suitable display. For example, the display **22** may be a liquid crystal display (LCD) screen, a tablet computer, computer monitor, television, touchscreen, and so forth. Furthermore, the virtual workpiece **128** may be configured with markers (e.g., such as the markers described in detail above) to be detected by the detection system **12**. In such an embodiment, the detection system **12** may be synchronized with the display **22** to minimize flicker. In some embodiments, a holographic projection may be used to display the virtual workpiece **128**, a virtual welding bead, and/or a virtual welding arc, among other things. In addition, the virtual workpiece **128** may include virtual guides to direct a welding operator to change their torch angle and/or travel speed. Certain embodiments may also display a virtual representation of the welding torch **26**. In such embodiments, the virtual weld may be performed a suitable distance away from the display **22**, such as by using a welding workpiece **28**.

FIG. **13** is an embodiment of a method **132** for determining a position and an orientation of the welding torch **26** and the workpiece **28**. A first marker of the welding torch **26** may be detected using the motion detecting device **14** of the detection system **12** (block **134**). Furthermore, a second marker of the welding torch **26** may be detected using the motion detecting device **14** (block **136**). Likewise, a first marker of the workpiece **28** may be detected using the motion detecting device **14** (block **138**) and a second marker of the workpiece **28** may be detected using the motion detecting device **14** (block **140**). As may be appreciated, detecting a first or second marker using the motion detecting device **14** may include detecting a size, shape, and/or color of the marker. The position and the orientation (e.g., pitch, roll, etc.) of the welding torch **26** and the workpiece **28** may be calculated using the first and second markers of the welding torch **26** and the first and second markers of the workpiece **28** (e.g., via the detection system **12**) (block **142**). For example, a relative position and a relative orientation of the welding torch **26** may be calculated in relation to the workpiece **28**. Furthermore, a virtual representation of the welding torch **26** and/or the workpiece **28** may be shown on the display **22** of the detection system **12** (block **144**). In addition, a virtual position and/or a virtual orientation of the welding torch **26** on the display **22** may be adjusted as the position and the orientation of the welding torch **44** changes (block **146**). As may be appreciated, the display **22** may also include virtual guides (e.g., a target value, a range of values, etc.) to direct the welding operator to a proper torch angle (e.g., pitch, roll, etc.) and/or a proper travel speed.

As may be appreciated, using the systems, devices, and techniques described herein, a low cost welding training system **10** may be provided for training welding operators. The welding training system **10** may allow a greater number of welding operators to be trained and may provide the welding operators with a greater amount of time to use the welding training system **10** (e.g., due to its low cost). Furthermore, as described above, a gaming aspect of welding training may be provided to welding operators to enhance welding operator interest in the welding training system **10**.

While only certain features of the invention have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

The invention claimed is:

1. A welding training system comprising:

a position detecting system configured to detect a device distance between the position detecting system and a device within a field of view of the position detecting system, to detect a plurality of distances between the position detecting system and all other objects within the field of view of the position detecting system, and to produce a map corresponding to the device and to the other objects based at least in part on the detected device distance and the detected plurality of distances; and

a plurality of markers configured to be coupled to the device of the welding training system, wherein the plurality of markers is configured to be detected by the position detecting system to detect the device distance.

2. The welding training system of claim **1**, comprising a processing device configured to determine a position of the device based at least partly on data received from the position detecting system.

3. The welding training system of claim **1**, comprising a processing device configured to determine an orientation of the device based at least partly on data received from the position detecting system.

4. The welding training system of claim **1**, comprising a processing device configured to determine a pitch of the device, a roll of the device, a yaw of the device, or some combination thereof, based at least partly on data received from the position detecting system.

5. The welding training system of claim **1**, comprising a processing device configured to determine a travel speed of the device based at least partly on data received from the position detecting system.

6. The welding training system of claim **1**, wherein the device comprises a welding torch having the plurality of markers coupled thereon.

7. The welding training system of claim **1**, wherein the position detecting system is configured to create a three-dimensional (3D) point cloud, to detect the device distance between the position detecting system and the device within the field of view of the position detecting system based at least in part on the 3D point cloud, and to detect the plurality of distances between the position detecting system and all other objects within the field of view of the position detecting system based at least in part on the 3D point cloud.

8. The welding training system of claim **1**, wherein the position detecting system comprises a commercially available off-the-shelf computer accessory.

9. The welding training system of claim **1**, comprising a welding workpiece having the plurality of markers coupled thereon.

10. The welding training system of claim **1**, wherein each marker of the plurality of markers is different in shape, size, or color, or any combination thereof.

11. A welding training system comprising:

a position detecting system configured to detect a device distance between the position detecting system and a welding torch within a field of view of the position detecting system, to detect a plurality of distances between the position detecting system and other objects within the field of view of the position detecting system, and to produce a map corresponding to the welding torch and to the other objects, wherein the other objects comprise a display;

a first plurality of markers configured to be coupled to the welding torch, wherein the first plurality of markers is configured to be detected by the position detecting system to detect the device distance; and

the display configured to present a virtual workpiece and a simulated weld on the virtual workpiece when the welding torch is moved along the virtual workpiece.

12. The welding training system of claim **11**, comprising a processing device configured to determine a position and an orientation of the welding torch based at least partly on data received from the position detecting system.

13. The welding training system of claim **11**, comprising a processing device configured to determine a pitch of the welding torch relative to the virtual workpiece, a roll of the welding torch relative to the virtual workpiece, a yaw of the welding torch relative to the virtual workpiece, or some combination thereof, based at least partly on data received from the position detecting system.

14. The welding training system of claim **11**, comprising the welding torch having the first plurality of markers coupled thereon.

15. The welding training system of claim **11**, wherein the virtual workpiece comprises a second plurality of markers, and the second plurality of markers is configured to be detected by the position detecting system.

16. The welding training system of claim **11**, wherein the position detecting system comprises one or more emitters, an infrared camera, and an RGB camera.

17. The welding training system of claim **11**, wherein the display comprises a touchscreen.

18. The welding training system if claim **11**, wherein the virtual workpiece comprises a liquid crystal display screen, a computer monitor, or a television.

19. The welding training system of claim **11**, wherein the display is synchronized with the position detecting system to minimize flicker.

20. The welding training system of claim **11**, wherein the display is configured to present virtual guides to adjust a torch angle of the welding torch relative to the simulated weld, a travel speed of the welding torch relative to the simulated weld, or any combination thereof.

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